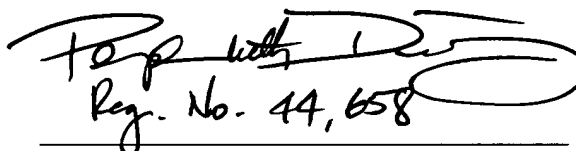## REMARKS

This Preliminary Amendment includes a Substitute Specification in which a literal translation of the original German patent application is revised in accordance with English idiom and U.S. patent practice. Care was exercised to avoid the introduction of new matter. An English-language abstract is also submitted.

Claims 1-12 are amended to recite the subject matter in customary U.S. format and to eliminate multiple dependencies. No new matter is introduced.

Favorable consideration of this application is respectfully requested. If any unresolved issues remain, it is respectfully requested that the Examiner telephone the undersigned attorney at (703) 425-8516 so that such issues may be resolved as expeditiously as possible.

Respectfully Submitted,

DITTHAVONG & CARLSON, P.C.

10/3/05
_____
Date

_____
Stephen C. Carlson
Attorney/Agent for Applicant(s)
Reg. No. 39929

10507 Braddock Road
Suite A
Fairfax, VA 22032
Tel. (703) 425-8516
Fax. (703) 425-8518

METHOD AND MEASURING DEVICE FOR DETERMINING AN ERROR RATE WITHOUT INCREMENTAL REDUNDANCY

5

FIELD OF THE INVENTION

The invention relates to a method and a measuring device
for determining an error rate in a data transmission from
10 a transmitter/receiver station to a transmitter/receiver
device, i.e. the decoding gain when using incremental
redundancy.

BACKGROUND OF THE INVENTION

15

~~In determining error rates, which~~Errors can occur during
the transmission of data from a transmitter/receiver
station, for example, a base station of a mobile
telephone system, to a transmitter/receiver device, for
20 example, a mobile telephone, and during the decoding
implemented in that context~~,~~. In determining error
rates for that context, a data transmission is generally
carried out between a measuring device and the mobile
telephone, wherein the base station of the mobile
25 telephone system is emulated by the measuring device. In
this context, the measuring device is structured in such
a manner that, like the base station itself, it fulfils
all requirements of the relevant standard, that is to
say, it also supports measures for software-assisted
30 error correction.

With more recent mobile-telephone systems, for example,
in the standard for EGPRS (Enhance General Packet Radio
Service), an incremental increase in redundancy is

implemented in order to increase security during
transmission of data. This means that after the
transmission of a first data block coded according to a
given convolutional coding scheme, tests are carried out
at the receiver end to determine whether the transmission
and the decoding of the received data has taken place
without error. If the data record received in this manner
contains errors, the transmission of further, redundant
data from the base station is requested by the receiver.

This so-called "Incremental Redundancy" is described, for
example, in US 5,657,325.

In this context, the redundant data are generated
together with the first data block from an originally
entered data record by convolutional coding, wherein
redundant information is generated for each item of
information in the original data record. For example,
with the coder MCS9 in the context of the EGPRS standard,
three bits are generated from every bit. To avoid the
necessity to transmit this threefold data volume in every
case, bits are removed from this threefold data volume
according to a punctuation scheme and stored in a memory.
The remaining bits are transmitted as a first data block
to the receiver, where they are evaluated.

In the event of an error transmission and evaluation of
the first data block received, the receiver reports the
error reception of the data to the transmitter, whereupon
redundant data in a second data block, formed according
to a second punctuation scheme by the elimination of bits
from the threefold data volume, are transmitted to the
receiver. Using these redundant data, the errors, which
have occurred in the reception of the first data block

can be corrected or another redundant data block is again requested.

In the context of a production testing system, for example, for evaluating the quality of a mobile telephone, the procedure described provides the disadvantage that when determining an error rate, which is caused by the mobile telephone, the errors originally occurring during the transmission are eliminated as a result of the incremental redundancy, and an evaluation of the actual errors caused by the hardware of the mobile telephone without correction by the software using the redundant data is therefore not possible.

SUMMARY OF THE INVENTION

~~The invention is based upon the object of~~A need therefore exists for providing a method and a measuring device, with which the error rate for a transmitter/receiver device is determined without an error correction with redundant data.

~~This object is achieved by the method according to the invention as specified in claim 1 and the measuring device according to the invention as specified in claim 7.~~

According to the method of an aspect of the invention, in order to test the correctness of the transmitted data after the transmission and decoding, a check parameter for the original data is added from an original data record to the original data block, initially through a method as used e.g. in the operation of a base station according to the EGPRS standard. The original data block

is coded by convolutional coding together with the check parameter, so that an enlarged data volume is generated, in which the original information of the original data block is present in a multiply redundant manner.

5

Several data blocks are generated from this enlarged data volume, each data block containing the information of the original data block including the check parameter, but often no other redundant information. A first data block

10 of this kind is modulated and amplified by a transmitter/receiver station of the measuring device in a known manner and finally transmitted via an antenna.

This first transmitted data block is received by a

15 transmitter/receiver device, i.e. the device under test (DUT), and decoded according to the coding scheme ("convolutional code") of the transmitter/receiver station. The data record obtained in this manner is checked on the basis of the check parameter with

20 reference to its agreement with the original data block. In this context, if an error in the transmission and the decoding is determined in the transmitter/receiver device, then the transmitter/receiver device requests a transmission of a further, redundant data block from

25 transmitter/receiver station.

This request from the transmitter/receiver device is received by the transmitter/receiver station, whereupon the same data block, which was originally transmitted, is

30 transmitted again. As a result of this retransmission of the same data block, the transmitter/receiver device receives no redundant information and cannot therefore correct a decoding error using incremental redundancy. The errors actually occurring in the transmission of data

as a result of the device can therefore be determined
with this method.

~~Advantageous~~ Additional aspects of some embodiments of
5   the invention relate to further developments of the
method and the measuring device ~~according to the~~
~~invention are specified in the dependent claims~~.

~~In~~ For example, in generating the redundant data blocks,
10   it is particularly advantageous if, instead of the
various, redundant data blocks, the same data block,
which is provided for the first transmission, is stored
at all of the memory positions provided in a memory for
the various redundant data blocks. The further selection
15   of a given data block in the event of the new request by
the transmitter/receiver device is then no longer
necessary. For example, after an error transmission, if a
second, redundant data block is requested, the data block
stored at the memory position of the second, redundant
20   data block can then simply be transmitted, because this
is identical to the previously transmitted data block.

According to a further advantageous development of the
invention, a redundant data block is stored in each of
25   the various memory positions of the memory. In order to
determine the error rate without an error correction, the
respective data block, which was originally transmitted,
is selected by a selection device independently of the
requested transmission of a further redundant data block.
30   This is particularly advantageous, if the error rate
which occurs when using redundant information is also to
be determined in addition to the error rate without an
error correction. In a case of this kind, according to a
further advantageous embodiment, the redundant

information requested on the basis of a request by the
transmitter/receiver device for a redundant data block
from the transmitter/receiver station can actually be
transmitted by sending a data block stored in the memory.

5

Furthermore, it is particularly advantageous to be able
to alter the punctuation scheme used, in order to
determine in a targeted manner the error rate caused by
the hardware in each case for different punctuation

10   schemes.

Still other aspects, features, and advantages of the
present invention are readily apparent from the following
detailed description, simply by illustrating a number of

15   particular embodiments and implementations, including the
best mode contemplated for carrying out the present
invention. The present invention is also capable of
other and different embodiments, and its several details
can be modified in various obvious respects, all without

20   departing from the spirit and scope of the present
invention. Accordingly, the drawing and description are
to be regarded as illustrative in nature, and not as
restrictive.

25   BRIEF DESCRIPTION OF THE DRAWINGS

Preferred exemplary embodiments of the invention are
explained in greater detail below on the basis of the
drawings. The drawings are as follows:

30

Figure 1   shows a schematic presentation of the
             structure of a transmitter/receiver station
             and a transmitter/receiver device for
             determining an error rate;

Figure 2   shows a schematic presentation of the transmission of data in data blocks in the context of EGPRS;

Figure 3   shows a schematic presentation of the time characteristic in the case of a retransmission of a data block;

Figure 4   shows a measuring arrangement with a measuring device according to the invention and a mobile telephone;

Figure 5   shows a schematic presentation of the generation and transmission according to the invention of data blocks; and

Figure 6   shows a schematic presentation of error correction by means of incremental redundancy.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Before the method according to the invention is explained in detail, the transmission of data using incremental redundancy will first be explained with reference to Figure 1. Data transmission takes place via an air interface, information being transmitted both from a transmitter/receiver station 1 to a transmitter/receiver device 2 and also vice versa.

The data to be transmitted, which are present in digital form, are first processed by a coding block 3 in the transmitter/receiver station 1. The data output from the

coding block 3 are modulated in a transmitter/receiver block 4, amplified and then transmitted via an antenna 5.

The signals transmitted by the antenna 5 are received by an antenna 6 of the transmitter/receiver device 2 and supplied to a transmitter/receiver block 7 of the transmitter/receiver device 2. The transmitter/receiver block 7 is connected to a decoding block 8, in which the original data are recovered from the coded data and checked for correctness.

The data are coded in the coding block 3, which, for this purpose, receives an original data block 9, for example, of 600 bits length, at its input end and initially supplies this to a check-parameter section 11. In the check-parameter section 11, a check parameter, which is calculated from the data of the original data block 9, is added to the original data block 9. A check parameter of this type can be determined, for example, using a CRC method (cyclic redundancy check). The original data block 9 is then supplied together with the check parameter to a coding section 12.

In the coding section 12, additional redundant data are generated from the original data of the original data block 9 together with the check parameter by convolutional coding, for which purpose a so-called "convolutional coder" is used. In this context, for example, in the case of a 1/3 coder, a second and third redundant bit are generated for each bit of the original data block 9 and the check parameter, as shown in Figure 5.

The data record 100 contains multiply redundant
information both with regard to the original data block 9
and also the added check parameter. To avoid unnecessary
data transmission, redundant bits are removed from the
data record generated in this manner, in punctuation
section 13 (Figure 1), with the assistance of a given
punctuation scheme P1, so that finally, a first data
block 101 remains, which contains the information of the
original data block 9 and the check parameter without
redundant information.

Moreover, further redundant bits are removed in the
punctuation section 13 using a further punctuation scheme
P2, thereby forming a second data block 102, which
differs from the first data block 101, but contains the
same information as the first data block 101. In the same
manner, a third, also redundant data block 103 is
generated using a third punctuation scheme P3.

The first, second and third data blocks are stored in
memory positions 15.1, 15.2 and 15.3 of a memory provided
for this purpose. Using a selection device 16, the data
blocks stored in the memory positions 15.1 to 15.3 can be
removed from the memory and supplied to the
transmitter/receiver block 4 of the transmitter/receiver
station 1. If a first transmission of the information is
provided for an original data block 9, then, for example,
the first data block, which is stored, for example, in
memory position 15.1, is always supplied to the
transmitter/receiver block 4. Alternatively, the data
blocks can also be newly generated in a continuous
manner.

The transmitter/receiver block 4 comprises the devices required for processing the first data block; by way of example, only a modulator 17 and amplifier are illustrated. After the first data block has been modulated in the modulator 17, it is amplified by the amplifier 18, so that it can then be transmitted via the antenna 5.

If the transmitter/receiver block 7 of the transmitter/receiver device 2 receives this signal via the antenna 6, then, in the transmitter/receiver block 7, the received signal is first amplified in a reception amplifier 19 and then demodulated in a known manner in a demodulator 20. The demodulated data of the first data block received are then supplied to the decoding block 8, where they are initially decoded in a decoding section 22 using the coding method used in the coding section 12.

The data from the first data block now present in decoded form are checked in a check section 23 with reference to their identity with the original data block 9. If the data determined from the first transmitted data block and the original data block 9 are found to be identical, a new original data block can be transmitted in a subsequent stage via the connection between the transmitter/receiver station 1 and the transmitter/receiver device 2.

By contrast, if the check section 23 determines that the data determined from the first data block transmitted do not agree with the original data block, then the data determined from the first transmitted data block are stored in a first storage position 25.1 of a receiver memory 24. In order to obtain the complete information

using these already-received data, the
transmitter/receiver device 2 transmits a signal to the
transmitter/receiver station 1 requesting a further,
redundant data block, in order to correct the errors
5   using the further redundant data. In this context,
because of the different data blocks, the second data
block also need not be transmitted in a completely error-
free manner, in order to guarantee adequate redundancy
for an error correction.
10

On the basis of this request, a different data block from
the previously-transmitted data block is selected by the
selection device 16 in the transmitter/receiver station
1, for example, the data block, which is stored in the
15   second memory position 15.2 of the memory 14. Another
evaluation is implemented in the decoding block 8 with
the data of the second data block received, which is
redundant to the already-received first data block. If
the complete correctness of the data determined and
20   therefore an error free transmission is still not
achieved in spite of the redundant information, the data
determined from the second transmitted data block 102 are
stored in a second memory position 25.2 of the receiver
memory 24.
25

Following this, the transmitter/receiver device 2 once
again transmits a signal requesting a further redundant
data block, whereupon the third data block, which is
stored in the third memory position 15.3 of the memory
30   14, is selected by the selection device 16, and the third
data block is supplied to the transmitter/receiver block
4 for transmission.

This procedure for the correction of errors is
illustrated schematically in Figure 6. Useful data 105
are determined from a first, transmitted data block 101,
which originated from the use of a first punctuation

5   scheme P1. A portion 105′ of the useful data 105 in this
context contains errors. Even after the reception and
decoding of a second data block 102 generated using a
second punctuation scheme P2, errors 106′, which were
determined with the information from the first and second

10 data blocks 101 and 102, may still be contained in the
useful data 106. Finally, the retransmission of redundant
information in the form of a third data block 103
generated with a third punctuation scheme can lead to a
correct communication of the useful data 107 of the

15 original data blocks 9. If this is still not the case,
the transmission of the data block 101 generated with the
first punctuation scheme P1 is again continued.

According to the invention, however, specifically for

20 testing purposes, in the event of a request for a further
data block, a transmission by the selection device 16 of
a further data block redundant to the previously-
transmitted data block is prevented. In evaluating the
data of a first data block received, if the check section

25 23 determines that the determined data do not agree with
the original data block 9, a signal requesting a further
redundant data block is transmitted from the
transmitter/receiver device 2, as is also the case in the
real operational conditions described above. The

30 transmitter/receiver device 2 cannot detect that a test
is being carried out.

By contrast with operation with a real base station,
however, to prevent a software error correction from

concealing a hardware error, the same data block, which
led to the error evaluation, is retransmitted by the
transmitter/receiver station 1 associated with the
measuring device, which emulates a real base station, as
5   shown for the first data block 101 in Figure 5. For this
purpose, the selection device 16 can again access, for
example, the first memory position 15.1 of the memory 14.

Alternatively, in generating the redundant data blocks,
10   the first memory position 15.1, the second memory
position 15.2 and the third memory position 15.3 of the
memory 14 can also each be occupied with the same data
block instead of with redundant data blocks. After a
transmission of the first data block by the
15   transmitter/receiver device 2, if a further, redundant
data block is requested via a response signal, the data
block stored in the second memory position 15.2 can then
actually be selected by the selection device 16. In this
manner, the same algorithm for selecting a data block can
20   be used as in the case of a real base station, but
without communicating redundant information to the
transmitter/receiver device 2.

Figure 2 illustrates the data transmission for a mobile
25   telephone system according to the EGPRS standard in a
considerably simplified form. The data are transmitted
between the transmitter/receiver station 1 and the
transmitter/receiver device 2 respectively in at least
one time slot. In each case, eight time slots together
30   form a frame. Figure 2 illustrates a first frame 30, a
second frame 40, a third frame 50, a fourth frame 60, and
a fifth and sixth frame 70 and 80 respectively. In this
context, the first frame 30 is subdivided into eight time

slots 31 to 38, the second frame 48 is correspondingly subdivided into eight time slots 41 to 48 and so on.

To transmit the data from the transmitter/receiver station 1 to the transmitter/receiver device 2 in a given time slot of a frame, one burst is transmitted in each case.

In Figure 2, a first burst 39 is transmitted in a third time slot 33 of the first frame. Another burst 49 is transmitted in a third time slot 43 of the second frame 40. Accordingly, in the third frame 50 and the fourth frame 60, a third and fourth burst 59 and 69 respectively are once again transmitted in the third time slot 53 and 63 respectively. In each case, four bursts of this kind 39, 49, 59 and 69, which are transmitted in the successive frames 30, 40, 50 and 60, together form a data block.

For the other frames 70, 80 and so on, the use of another time slot between the transmitter/receiver station 1 and the transmitter/receiver device 2 can also be agreed, in order to transmit the next data block, which is once again transmitted between the transmitter/receiver station 1 and the transmitter/receiver device 2 subdivided into four bursts. The transmission of a first data block or a further data block, as described with reference to Figure 1, therefore extends over four successive frames.

Once again in a considerably simplified form, Figure 3 shows that, after the transmission of a data block 90 of this kind and in response to a request from the transmitter/receiver device 2, other data blocks 91 can

be transmitted, before a redundant data block 92 is
transmitted and/or, with the method according to the
invention, before the same data block is transmitted for
a second time in order to determine an error rate.

5   Normally, a given maximum time interval between the data
block 90, which has been evaluated as incorrect, and the
retransmitted data block 92 must not be exceeded. Because
of the defined duration of approximately 20 ms, which an
individual data block requires for transmission, this

10   maximum time interval can be indicated as a maximum
number of data blocks N_{max}, as illustrated in Figure 3.

Figure 4 shows an arrangement for determining the error
rate of a mobile telephone 93. The mobile telephone 93 in

15   this context provides the transmitter/receiver device 2
illustrated in Figure 1. The mobile telephone 93
continues to be in radio contact with a measuring device
94, which comprises the transmitter/receiver station 1
also familiar from Figure 1, wherein the information

20   required for determining the error rate for data blocks
received correctly or incorrectly from the mobile
telephone 93 is also communicated to the measuring device
94 via the radio connection.

25   A controller 95, which is connected to the
transmitter/receiver station 1 of the measuring device
94, is additionally provided in the measuring device 94.
The controller 95 can therefore communicate a given
original data block 9, for example, to the

30   transmitter/receiver station 1. Moreover, the controller
95 receives from the transmitter/receiver station 1 the
information transmitted via the air interface between the
antennae 5 and 6 regarding which data blocks could not be

correctly evaluated in their entirety by the decoding
block 21.

In this context, the information regarding which data
blocks could not be correctly received and evaluated is
not normally communicated by the mobile telephone 93 to
the measuring device 94 individually for each data block,
but is summarised for a number of data blocks received.
The error rate is determined by the controller 95 on the
basis of the information regarding the number of
correctly or incorrectly transmitted data blocks and
supplied, for example, for presentation on a display 96.

Additionally, the controller 95 can determine for the
transmitter/receiver station 1, that, in order to receive
a comparison of the error rates of the mobile telephone
93 with and without incremental redundancy, in response
to a request from the mobile telephone 93, another data
block different from the data block but redundant to the
data block is transmitted instead of the retransmission
of the same data block. The result of this additional
evaluation is then also presented on the display 96.

In the event of a measurement without incremental
redundancy, the punctuation scheme used to generate the
first data block and also therefore the data blocks to be
retransmitted can preferably be determined in a variable
manner by the measuring device 94. A corresponding input
is supplied by the controller 95 to the
transmitter/receiver device 1 and taken into
consideration in selecting the data blocks to be
transmitted by the selection device 16. If the memory
positions 15.1 to 15.3 are occupied with identical data
blocks, the punctuation scheme determined by the

controller 95 is already taken into consideration in the storage of the data blocks.

While the present invention has been described in connection with a number of embodiments and implementations, the present invention is not so limited but covers various obvious modifications and equivalent arrangements, which fall within the purview of the appended claims.

Claims WHAT IS CLAIMED IS:

1. Method for determining an error rate in a data
    transmission from a transmitter/receiver station
    (1) to a transmitter/receiver device (2), wherein a
    first data block and at least one further,
    redundant data block different from the latter are
    generated by the transmitter/receiver station (1)
    from an original data block (9) and, in the event
    of an error transmission of the first data block, a
    further, redundant data block is requested by the
    transmitter/receiver device (2), comprising the
    following procedural stages:
    - transmission of a first data block by the
    transmitter/receiver station (1),
    - reception of the first data block by the
    transmitter/receiver device (2),
    - decoding of the first data block received in a
    decoding block (8),
    - checking the first data block for transmission
    errors,
    - requesting a further, redundant data block for
    error correction, if an error is determined in the
    transmitted data of the first data block,
    - reception of the request in the
    transmitter/receiver station (1),
    characterised by
    - retransmission of the first data block instead of
    a redundant data block, and
    - determination of the rate of the incorrectly
    received first data blocks.

2. Method according to claim 1,

characterised in that

the first data block and the further, redundant
data blocks are generated by convolutional coding
with different punctuation schemes.

5

3. Method according to claim 2,

   characterised in that

   the punctuation scheme used for the generation of
   the first data block is determined.

10

4. Method according to any one of claims 1 to 3,

   characterised in that

   the different, redundant data blocks are stored in
   a memory (14) of the transmitter/receiver station

15   (1) and that the first data block stored in a
   memory position (15.1) assigned to the first data
   block is transmitted in the event of a request for
   the further data block.

20 5. Method according to any one of claims 1 to 3,

   characterised in that

   the first data block is also stored in a memory
   (14) of the transmitter/receiver station (1)
   instead of the different, redundant data blocks and

25   in their respective memory positions (15.2, 15.3),
   and that the data block stored in the respective
   memory position (15.2, 15.3) is transmitted in the
   event of a request for a further data block.

30 6. Method according to any one of claims 1 to 3,

   characterised in that,

   a further, redundant data block is additionally
   transmitted by the transmitter/receiver station (1)
   in the event of a request for a further data block,

in order to compare the determined error rate
without error correction with an error rate with
error correction by incremental redundancy.

5   7.   Measuring device for determining an error rate in
         the event of a data transmission from a
         transmitter/receiver station (1) to a
         transmitter/receiver device (2), wherein the
         transmitter/receiver station (1) provides a coding
10   block (3) for generating from an original data
         block (9) a first data block and at least one
         further, redundant data block different from
         latter, and a selection device (16) for selecting a
         data block to be transmitted,
15   **characterised in that**
         the first data block is retransmitted by the
         transmitter/receiver station (1) instead of a
         redundant data block in response to a request for a
         further, redundant data block communicated by the
20   transmitter/receiver device (2) to the
         transmitter/receiver station (1) because of a error
         transmission of the first data block.

    8.   Measuring device according to claim 7,
25   **characterised in that**
         a memory (14) with several memory positions (15.1,
         15.2, 15.3) is provided in the coding block (3) for
         the storage of data blocks.

30   9.   Measuring device according to claim 8,
         characterised in that
         different punctuation schemes are used for the
         generation of the respective data blocks, and that

the punctuation scheme used for the generation of
the first data block can be selected.

10. Measuring device according to any one of claims 7
to 9,
characterised in that
the first data block can be selected by the
selection device (16) from the memory (14), where
it is stored, independently of the request from the
transmitter/receiver device (2).

11. Measuring device according to claim 7 or 8,
characterised in that
the first data block is stored instead of the
further, different, redundant data blocks at their
respective memory positions (15.2, 15.3) in a
memory (14).

12. Method according to claim 7 or 8
characterised in that
a further, redundant data block is selected by the
selection device (16) in the event of a request by
the transmitter/receiver device (1) in order to
compare the determined error rate without error
correction with an error rate with error correction
by incremental redundancy.

ABSTRACT OF THE DISCLOSURE

A method and device are described for determining an
error rate during transmission from a
transmitter/receiver station to a transmitter/receiver
device and a measuring device. A first data block and at
least one other and different redundant block is received
by the transmitter/receiver device, decoded, and checked
for transmission errors. If an error is ascertained in
the first data block, another redundant block is
requested, but in response the first data block is
retransmitted instead.